Simulating Physical Problems on a Quantum Computer

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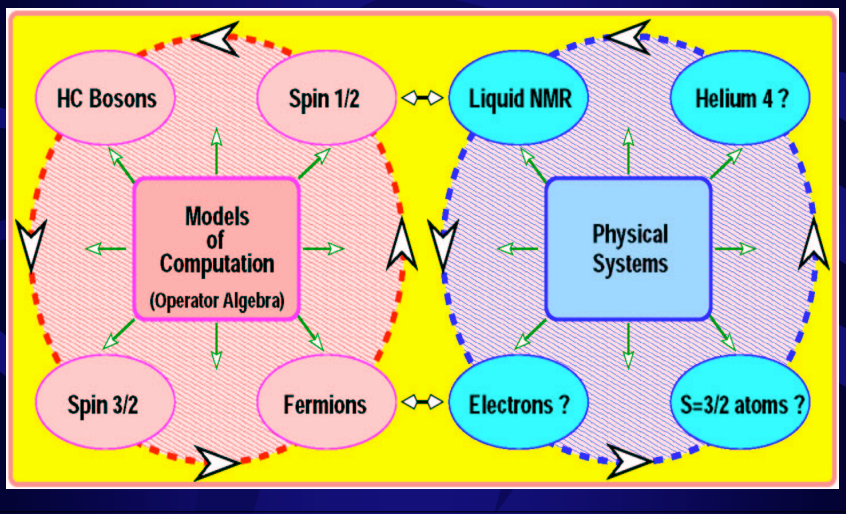
Operative Question and Objective

- **Q**: If a large quantum computer existed today, what significant physical problems could we efficiently solved on it?
- **A**: Almost none. The limitation is the absence of the right quantum algorithms.
- **Objective:** development of efficient quantum algorithms to solve quantum problems.

Results To-Date

- Demonstrated the transmutablity of different realizations of quantum computers and quantum algorithms for these realizations.
- Illustrated this for fermions and spin _ systems.
  - Proved the fermion sign problem in general will not occur on a quantum computer.
  - Grassmanian chip.
- Solved a fermion problem on a spin _ quantum computer.

Quantum Computation Transmutations



Proof of Principle

- Solution of a fermion problem using 3 qubits of a NMR (quantum spin _) quantum computer
  - Amplitude of resonant impurity scattering of a spinless fermion on a ring